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D. M. Gossett, Dean
Patterns of Forage Intake, Milk Yield, Calf Growth and Efficiency of Angus Cow-Calf Pairs Grazing Fescue-Legume or Fescue Pastures

J. W. Holloway and W. T. Butts, Jr.

SUMMARY

Patterns of forage quality, forage intake, cow weight and fatness, milk production, calf growth and efficiencies of milk production and calf growth were measured over 5 years for 197 mature Angus cows. These cows calved January through March and grazed either fescue-legume (70% fescue, 30% red and ladino clover and lespedeza) or fescue pastures. Forage quality and intake were measured by an internal (H₂SO₄ acid detergent lignin), external (Cr₂O₃) dilution technique for cows (continuous estimate from April 30 to September 29) and calves (3 trials on May 30, June 29 and Aug. 29). Cows and calves were weighed and milk production measured (weigh-suckle-weigh technique) monthly during this time. Forage DE concentration for fescue-legume was greater at any time than that for fescue and decreased as the season progressed at a much less rapid rate. Cows grazing fescue-legume maintained greater...
forage DE intakes than those grazing fescue mainly because the rate of decline as the season progressed was not nearly as great. Rate of weight and back-fat accumulation was much greater for cows grazing fescue-legume than for those grazing fescue, although the rate of weight accumulation was more rapid than the rate of backfat accumulation for cattle grazing both types of pasture. As the grazing season progressed, initial (April 30) advantages held by animals grazing fescue-legume for milk production and calf weight became greater. Large advantages (P<.01) were noted for animals grazing fescue over those grazing fescue-legume for efficiency of milk production and calf growth. However, the large differences in gross efficiency between pasture types were noted only after differences in cow weight and rate of backfat accumulation were detected (June 29 - September 29). These differences between pasture types in gross efficiencies were thus probably results of confounding effects of other energy expenditures and not due to differences in net efficiency.

INTRODUCTION

Kentucky-31 tall fescue is the prevalent forage specie in the upper southeastern United States. It is a cool-season grass that normally becomes dormant during the summer resulting in lowered digestibility and animal performance during that season (Kaiser et al., 1974). The addition of legumes to fescue swards has been suggested as a possible means of at least partially alleviating this reduced animal performance during the summer (Burns et al., 1973). Variation among animals and among forage systems in efficiency of milk production has been attributed to variation in amount of weight change during lactation (Moe et al., 1971; Reid and Robb, 1971). Thus, gross composite observations of lactational or weaning efficiency might be attributed to the seasonal pattern of nutrient intake and use of grazing cattle. Very little work has been reported concerning seasonality of forage quality, animal intake and utilization of forage for cattle grazing fescue-legume or fescue pastures. Preliminary work from this experiment indicated that cattle grazing fescue had greater gross efficiencies of weaned calf production than those grazing fescue-legume (Holloway and Butts, 1982). The purpose of this paper was to study the influence of the addition of legumes to fescue swards on seasonality of (1) forage quality, (2) forage intake by cow and calf, (3) cow weight and fatness, (4) milk yield, (5) calf growth and (6) efficiencies of milk yield and calf growth. A concurrent study of these seasonal patterns was utilized in an attempt to understand the underlying causes for large differences in gross efficiency of production of weaned calf reported by Holloway and Butts (1982) for cattle grazing fescue-legume or fescue pastures.
PROCEDURE

Pasture and Animal Management. Seasonal trends in forage intake, productivity and efficiency for 197 cow-years were measured over 5 years (1976-1980). Mature Angus cows (4-12 years of age) calved in January through March and calves were weaned in October (at about 240 days of age). All male calves were castrated in April of each year.

Cows were randomly allotted to either fescue-legume or fescue pastures at calving time. Fescue-legume pastures consisted of about 60 to 70% Kentucky-31 tall fescue (IFN 2-01-920) and 30 to 40% legume consisting of red clover (IFN 2-01-434), Korean and Kobe lespedeza (IFN 2-02-598) and ladino clover (IFN 2-01-383). This mixture was assured by overseeding 5.4 kg (11.9 lb) Korean lespedeza, 4.5 kg (9.9 lb) Kobe lespedeza and 2.7 kg (5.9 lb) red cover/ha in March of each year. Ladino clover had a tendency to invade the pastures. Fescue pastures were almost homogeneous swards of tall fescue. They were sprayed with the herbicide, Banvel\textsuperscript{3}, each June as a precautionary measure to maintain homogeneous fescue swards. All pastures were fertilized with P and K in March of each year as needed according to soil tests. Both types of pasture were mowed for hay in June of each year. Within pasture type, cows were allotted to two 8.1-ha (20-acre) pastures (10 cows with calves/pasture/yr). Cows and calves were rotated between pastures within pasture type each week.

Twenty to forty percent of the cows were replaced each fall. A few animals died during the 5-yr. duration of the project and all data concerning them were omitted. Cows in the two pasture types received hay harvested from their respective pastures during the winter. No residual effect of the previous year’s treatment in terms of initial cow weight and fatness (April 30) could be detected.

Estimation of Forage Intake and Digestibility. Total fecal dry matter (DM) excretion was estimated in a continuous manner for each cow for a period of 152 days (April 29 - September 28) by the Cr\textsubscript{2}O\textsubscript{3} dilution method. Each cow was confined for short periods (10 minutes/feeding) at 0800 and 1700 hr each day and fed 227 g (.5 lb)/feeding of a pelleted feed containing Cr\textsubscript{2}O\textsubscript{3} (76.4% TDN, Holloway et al., 1979). One fecal sample was collected from each cow each week at 0800 and 1700 hr during the 22-week feeding period (8,800 samples).

Fecal samples were frozen until DM (60 C, AOAC, 1975), chromium (Williams et al., 1962), and H\textsubscript{2}SO\textsubscript{4} acid detergent lignin (ADL, Goering and Van Soest, 1970) determinations were made. Diurnal excretion pat-
terns of Cr\textsubscript{2}O\textsubscript{3} for these cows during 1976 were described by regression procedures (Hopper et al., 1978). The equations developed were employed to adjust Cr\textsubscript{2}O\textsubscript{3} values obtained for samples collected at 0800 and 1700 hr for diurnal excretion. Adjusted values were employed as a data set in regression procedures for estimating percentage of Cr\textsubscript{2}O\textsubscript{3} in fecal DM for each cow during the grazing period. Morning and evening fecal ADL percentages for each cow did not differ (P>.10) and were averaged on a weekly basis to arrive at percentage of ADL in fecal DM. Average values were employed as a data set in regression procedures for estimating percentage of ADL in fecal DM for each cow.

A cage and strip procedure employing bi-weekly clippings of five caged and uncaged (strip) areas/pasture was employed for the first 3 years of the project to determine degree of selectivity and, thus, method of obtaining the appropriate forage sample (Lineham, 1952). Samples were taken from these clippings and frozen until DM (60 C, AOAC, 1975), ADF and ADL (Goering and Van Soest, 1970) were determined. Percentages of ADF and ADL in available and consumed forage were calculated (Linehan, 1952) and no differences (P > .20) were detected. Thus, percentage of ADL in consumed forage was assumed to be that estimated from the strip samples and these values were employed in regression procedures. During the last 2 years of the experiment, 20 random forage samples/pasture were clipped at bi-weekly intervals to obtain estimates of ADL consumed.

For all regression procedures described, stepwise methods were used to determine best fitting models. Linear and quadratic terms were determined to be adequate for describing trends in variables over time. Regression equations for estimating Cr\textsubscript{2}O\textsubscript{3} and ADL in fecal DM (for each cow) and ADL in forage DM (for each pasture) were evaluated for each day of the experimental period each year. Predicted values were then used in calculations to estimate DM intake and DM digestibility for each cow each day of the experiment. Regression equations were then employed to describe seasonal changes in these variables. Digestible energy (DE) was calculated from DM digestibility by the method of Heany and Pigden (1963).

Three forage intake and digestibility trials were conducted with the calves each of the last 4 years of the project utilizing an external (Cr\textsubscript{2}O\textsubscript{3}), internal (ADL) indicator technique (Crampton and Harris, 1969). Trials consisted of 5-day preliminary and 5-day collection periods at the average dates of May 30, June 29 and August 29. Calves were bolused with 2.5 g (.006 lb) Cr\textsubscript{2}O\textsubscript{3} at 0800 hr and again at 1700 hr each day of each trial. Fecal samples were also collected at these times during the collection periods and were composited on a wet weight basis to provide one sample/calf/trial. These samples were analyzed for DM, ADL and Cr as were samples obtained from the cows. Forage samples were obtained by selectively clipping forage similar to that which the calves were observed
to be grazing. Twenty samples were taken from each pasture type during each trial and analyzed in a similar manner as the feces for DM and ADL. Forage DM intake and DM digestibility were calculated by the method of Crampton and Harris (1969) and DE was calculated from DM digestibility by the method of Heany and Pigden (1963).

Forage samples from digestibility studies of both the cow and the calf were also analyzed for *in vitro* DM digestibility by the two-stage technique of Tilley and Terry (1963) for corroborative evidence. Values were quite similar and highly correlated (P<.01, R²>.80) with those found by ADL ratio.

**Estimation of Cow Weight and Backfat.** Cows were weighed and backfat measured ultrasonically4 at the 12th rib every 2 weeks from time of calving (beginning the day after calving) until a minimum weight was attained, and then once per month until the calves were weaned. Each cow’s weight was regressed on time in Julian days by the Gauss-Newton iterative process. This method determined the least squares estimates of the Fourier coefficients (Bliss, 1967) of a periodic model (Brown et al., 1980). Polynomials were used to describe the change in backfat over time. Stepwise procedures were used to determine the best filling models. Only linear and quadratic effects of time, however, were important.

**Estimation of Milk Production and Calf Growth.** Twent-four-hour milk productions were estimated at monthly intervals beginning in April of each year (7 estimates/yr). Milk production estimation was begun each year before the cows had reached peak lactation. A weigh-suckle-weigh technique was employed involving two consecutive 12-hr separations of cows and calves. Calves were confined with their dams at 1700 hr and then separated from them at 1800 hr for a 12-hr period. They were then weighed before and after nursing the next morning at 0600 hour. They were again separated from their dams until 1800 hr at which time the weigh-suckle-weigh procedure was repeated. The shape of the lactation curve for each cow was described by the equation of Wood (1977). Milk composition was estimated from samples obtained by a total milk-out procedure during May, June and July. After a 3-hr cow-calf separation, cows were restrained and injected with 20 IU of oxytocin intramuscularly. They were then milked with a milking machine. The

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4Ultrasonic Animal Tester-Sonoray®, Model 12, Bronson Instruments, Inc., Bethel, Conn.
resultant sample was mixed and subsampled for butterfat and total solids analyses. Milk gross energy (GE) was then calculated by the equation of Tyrrell and Reid (1966). Each calf’s growth pattern was described by fitting quadratic polynomials to a series of each calf’s weights taken at monthly intervals (with overnight shrinks) from birth to weaning.

Statistical Analyses. Equations developed for each variable of interest were evaluated for Julian days 120 (April 30), 150 (May 30), 180 (June 29), 210 (July 29), 240 (Aug. 29), and 270 (Sept. 28) to obtain data sets for analysis. These data sets were analyzed by regression procedures employing the model:

\[ Y = \text{yr, sex, calf birth date, pasture type, all two-way interactions excluding those involving year} \]

RESULTS AND DISCUSSION

Forage Quality and Intake. Forage quality and intake variables are presented in table 1 and figures 1 and 2. Both cows and calves grazing fescue-legume consumed forage of higher energy density throughout the season than those grazing fescue. A possible source of bias associated with technique has been discussed by Holloway et al., 1979, and results from partial digestibility of ADL in legumes. If ADL is partially digested in the legumes, then DM digestibility and intake would be biased downward. The rate of decrease in forage energy density consumed by the cows grazing fescue-legume during the spring was much less than for cows grazing fescue pastures so that the largest difference between pasture types was during the months of July and August (figure 1). Calves apparently consumed forage of higher energy density than cows grazing each pasture type although the advantage was greater for animals grazing fescue-legume.

Although the energy density of both pasture types decreased during the spring, DE intake decreased only for cows grazing fescue pastures (figure 2). Apparently, physical factors controlled intake of cows grazing fescue even during the spring, whereas other factors controlled intake of cows grazing fescue-legumes, at least until July 29. Several researchers studying dairy cows have found that intake is related to digestibility (controlled by physical factors) when DM digestibility is less than 67% (Campling et al., 1961; Conrad et al., 1964; Montgomery and Baumgardt, 1966). Since the maximum DM digestibility observed in this

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5 Mark III Milk-O-Tester ©

6
study was 67.3% (table 1), intake should have been related to energy dens-
ity for both pasture types throughout the grazing season. Nutt et al.
(1980), however, reported work from this experiment showing that intake
of cows grazing fescue was related to rumen capacity whereas no
relationship was detected for cows grazing fescue-legume. Blaser et al.
(1977) also has shown that for grasses and legumes of the same
digestibility, the rate of digestion for legumes is greater. Therefore, the
point of demarcation (digestibility) separating physical control from
energy need control is apparently different for cows grazing fescue-
legume than for those grazing fescue.

Both cows and calves grazing fescue-legume had greater (P< .05)
forage intakes than those grazing fescue at each date measured although
the largest advantage was during July and August when fescue was dor-
mant. No difference, however, could be detected (P>.05) between
pasture types in DE requirement for maintenance until July 29.
Therefore, an even larger relative advantage in DE intake above main-
tenance was detected early in the grazing season for cows grazing fescue-
legume over those grazing fescue (table 1).

Cow Weight and Backfat. Patterns of cow weight and backfat dur-
ing the grazing period are shown in table 2 and figure 3. Cows grazing
fescue-legume and fescue pastures maintained similar (P> .05) amount
of weight and backfat until June 29 (for fatness) and July 29 (for weight).
The rate of change in both weight and backfat, however, was different for
the two pasture types beginning on May 30 (table 2). Patterns of weight
and backfat were greatly different for cows grazing the two types of
pasture. Those grazing fescue legume had rapid increases in weight and
backfat while those grazing fescue experienced slower rates of increase
(figure 3). Cows grazing fescue-legume apparently utilized much larger
amounts of DE at any time for backfat accumulation and for main-
tenance than cows grazing fescue.

Pattern of weight accumulation does not appear to be highly related
with pattern of backfat accumulation (figure 3). Three possible explana-
tions for this are: (1) patterns of weight accumulation were influenced by
seasonal changes in fill, (2) the relatively large error of measurement
associated with ultrasonic estimates clouded those trends to the extent
that subtle changes were not detectable (average coefficients of variation
for fatness and weight were .53 and .11, respectively) or (3) realimenta-
tion of Angus cows involves accumulation of tissues other than fat or in
body water retention so that weight accumulations occur earlier than
fatness accumulation. As shown in figure 3, there is a definite lag be-
tween weight and backfat accumulation for cows in both pasture types.
Callow (1950) and Wooten et al. (1979) have shown that mature thin
cows that are allowed to gain weight accumulate protein first and then
fat. Berg and Butterfield (1976) also reported that fat deposits from thin
animals contain more water and less fat than those from fatter animals.
**Milk Production and Calf Growth.** Patterns of milk production and calf growth are shown in table 3 and figure 4. Cows grazing the two pasture types produced milk that was quite similar (P>.20) in energy density (323 and 318 Mcal GE/kg DM for cows grazing fescue-legume and fescue pastures, respectively). Cows grazing fescue-legume pastures produced more (P<.05) milk and therefore more (P<.01) milk DE at any time than those grazing fescue (table 3). Cows grazing fescue-legume appeared also to be more persistent in milk production than those grazing fescue (figure 4).

Calves grazing fescue-legume were heavier (P<.01) at any time than those grazing fescue although their advantage increased from 7.3 kg (16.1 lb) on April 30 to 23.3 kg (51.3 lb) on September 29 (table 3). This trend was the result of different growth rates and divergent growth patterns between calves grazing the two pasture types. Calves allowed fescue-legume grew at an ever increasing rate while calves allowed fescue grew at an ever decreasing rate as the season progressed (figure 4).

Thus, patterns of both milk production and calf growth appear to be divergent in that cattle grazing fescue-legume increased their advantage over those grazing fescue as the season progressed. The tendency for calves grazing fescue-legume to increase their advantage in weight more rapidly than those grazing fescue as lactation progressed was due to advantages in and divergent trends in both milk and forage DE intake (figure 1, 2 and 4).

**Efficiency.** Patterns of gross efficiency of milk production and calf growth are shown in table 3 and figure 5. Cattle grazing fescue-legume consumed more (P<.05) digestible DM than those grazing fescue and converted this advantage to increased milk production and calf growth. Their gross efficiencies of milk production and calf growth, however, were lower at any time later than June 29 than cattle grazing fescue (table 3 and figure 5). From July through September, cows grazing fescue-legume were much heavier (P<.01) and were accumulating fat at a much more rapid (P<.01) rate than those grazing fescue (table 2 and figure 3). Thus, the lower gross efficiency of both milk production and calf growth detected for cows grazing fescue-legume was at least partially due to greater energy expenditure for maintenance and tissue growth. The largest differences between pasture types in efficiency occurred after the large difference in weight had developed and during the time of large differences in backfat accumulation (figures 3 and 5). During the spring (before June 29), cows grazing fescue-legume consumed more forage DE (P<.05, table 1) than those grazing fescue and produced more milk DE (P<.05, table 3) but did not maintain larger amounts of weight or backfat (P>.05, table 2). As a result, cattle grazing fescue-legume had similar gross efficiencies of milk production as those grazing fescue (P>.05, table 4). This provides evidence that the pasture type differences in gross efficiencies are due at least partially to energy expenditures not included in these calculations.
and not due to differences in net efficiency. Work conducted with dairy cows has also indicated little animal variation in net efficiency (Moe et al., 1971).
LITERATURE CITED


Figure 1. Patterns of energy density of forage consumed by cows and calves.
Figure 2. Patterns of forage DE intake of cows and calves.
Figure 3. Patterns of cow weight and backfat.
Figure 4. Patterns of milk production and calf growth.
Figure 5. Patterns of efficiency of milk production and calf growth.
Table 1. Patterns of forage digestibility and intake of Angus cows grazing fescue-legume or fescue pastures\(^a\)

<table>
<thead>
<tr>
<th>Item</th>
<th>April 30</th>
<th>May 30</th>
<th>June 29</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fescue-legume</td>
<td>Fescue</td>
<td>RSDa</td>
</tr>
<tr>
<td>Cow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM intake, kg/day (lb/day)</td>
<td>9.6c (21.1)</td>
<td>9.2c (20.2)</td>
<td>1.35 (2.97)</td>
</tr>
<tr>
<td>DM digestibility, %</td>
<td>67.3c</td>
<td>66.5d</td>
<td>2.70</td>
</tr>
<tr>
<td>Digestible DM intake, kg/day (lb/day)</td>
<td>6.5c (14.3)</td>
<td>6.1d (13.4)</td>
<td>1.04 (2.29)</td>
</tr>
<tr>
<td>Forage DE, Mcal/kg DM (Mcal/lb)</td>
<td>2.99c (1.36)</td>
<td>2.96d (1.35)</td>
<td>1.17 (0.58)</td>
</tr>
<tr>
<td>DE intake, Mcal/day</td>
<td>28.9c</td>
<td>27.3d</td>
<td>4.68</td>
</tr>
<tr>
<td>DE requirement for maintenance, Mcal/day</td>
<td>16.1c</td>
<td>16.1c</td>
<td>1.34</td>
</tr>
<tr>
<td>DE intake above maintenance, Mcal/day</td>
<td>12.7c</td>
<td>11.1d</td>
<td>4.51</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calf</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forage DE, Mcal/kg DM</td>
<td>2.99e</td>
<td>2.74f</td>
<td>2.01</td>
</tr>
<tr>
<td>Forage DE intake, Mcal/day</td>
<td>9.67</td>
<td>6.76f</td>
<td>3.327</td>
</tr>
<tr>
<td>Forage DE intake of the calf as percent</td>
<td>22.94c</td>
<td>21.86c</td>
<td>6.413</td>
</tr>
<tr>
<td>of forage DE intake of the cow and calf</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cow and Calf</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forage DE intake, Mcal/day</td>
<td>39.37e</td>
<td>29.66f</td>
<td>5.464</td>
</tr>
</tbody>
</table>

\(^a\)Least squares means from the model: \(Y = \text{yr, sex, calf birth date, pasture type, all 2-way interactions excluding those involving yr.}\)

\(^b\)Residual standard deviation from the model.

\(^c,d\)Means on the same line within the same date with different superscripts are different (P<.05).

\(^e,f\)Means on the same line within the same date with different superscripts are different (P<.01).

\(^g\)DE requirement for maintenance = .077 x cow weight \(.75/\text{.58/ .80 according NRC, 1976.}\)

\(^h\)Estimates of forage intake of the calf were made only for the last 4 yrs of the 5 yr project.
Table 1. (Continued) Patterns of forage digestibility and intake of Angus cows grazing fescue-legume or fescue pastures\textsuperscript{a}

<table>
<thead>
<tr>
<th>Item</th>
<th>July 29</th>
<th>Aug. 29</th>
<th>Sept. 28</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fescue-legume</td>
<td>Fescue</td>
<td>RSD\textsuperscript{b}</td>
</tr>
<tr>
<td>Cow intake, kg/day (lb/day)</td>
<td>9.8\textsuperscript{e} (21.6)</td>
<td>7.6\textsuperscript{f} (16.7)</td>
<td>1.08 (2.38)</td>
</tr>
<tr>
<td>DM digestibility, %</td>
<td>63.4\textsuperscript{e}</td>
<td>57.8\textsuperscript{f}</td>
<td>1.86</td>
</tr>
<tr>
<td>Digestible DM intake, kg/day (lb/day)</td>
<td>6.2\textsuperscript{e} (13.6)</td>
<td>4.4\textsuperscript{f} (9.7)</td>
<td>7.1 (1.56)</td>
</tr>
<tr>
<td>Forage DE, Mcal/kg DM (Mcal/lb)</td>
<td>2.81\textsuperscript{c} (1.28)</td>
<td>2.55\textsuperscript{f} (1.16)</td>
<td>.088 (.040)</td>
</tr>
<tr>
<td>DE intake, Mcal/day</td>
<td>27.3\textsuperscript{e}</td>
<td>19.4\textsuperscript{f}</td>
<td>3.14</td>
</tr>
<tr>
<td>DE requirement for maintenance, Mcal/day\textsuperscript{g}</td>
<td>17.0\textsuperscript{c}</td>
<td>16.5\textsuperscript{d}</td>
<td>1.34</td>
</tr>
<tr>
<td>DE intake above maintenance, Mcal/day\textsuperscript{h}</td>
<td>10.4\textsuperscript{e}</td>
<td>2.8\textsuperscript{f}</td>
<td>2.98</td>
</tr>
<tr>
<td>Calf\textsuperscript{i}</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forage DE, Mcal/kg DM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forage DE intake, Mcal/day</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forage DE intake of the calf as percent of forage DE intake of the cow and calf</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cow and Calf\textsuperscript{j}</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forage DE intake, Mcal/day</td>
<td>43.79\textsuperscript{e}</td>
<td>33.61</td>
<td>5.932</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Least squares means from the model: Y = yr, sex, calf birth date, pasture type, all 2-way interactions excluding those involving yr.

\textsuperscript{b}Residual standard deviation from the model.

\textsuperscript{c,d}Means on the same line within the same date with different superscripts are different (P < .05).

\textsuperscript{e,f}Means on the same line within the same date with different superscripts are different (P < .01).

\textsuperscript{g}DE requirement for maintenance = .077 x cow weight .75/.58/.80 according NRC, 1976.

\textsuperscript{h}Estimates of forage intake of the calf were made only for the last 4 yrs of the 5 yr project.
Table 2. Patterns of cow weight and fatness change of Angus cows grazing fescue-legume or fescue pastures\(^a\)

<table>
<thead>
<tr>
<th>Date</th>
<th>April 30</th>
<th>May 30</th>
<th>June 29</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fescue-legume</td>
<td>Fescue</td>
<td>RSD</td>
</tr>
<tr>
<td>Cow weight, kg (lb)</td>
<td>448.0 (986)</td>
<td>447.2 (984)</td>
<td>48.62 (109.2)</td>
</tr>
<tr>
<td>Cow weight change, kg/day (lb/day)</td>
<td>.59 (1.30)</td>
<td>.48 (1.08)</td>
<td>.41 (0.90)</td>
</tr>
<tr>
<td>Cow fatness, mm (in)</td>
<td>6.5 (0.26)</td>
<td>5.9 (0.23)</td>
<td>3.09 (0.12)</td>
</tr>
<tr>
<td>Cow fatness change, mm/day x 10(^2) (in/day)</td>
<td>.35 (0.012)</td>
<td>.19 (0.004)</td>
<td>2.73 (0.108)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>July 29</th>
<th>Aug 29</th>
<th>Sept 28</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fescue-legume</td>
<td>Fescue</td>
<td>RSD</td>
</tr>
<tr>
<td>Cow weight, kg (lb)</td>
<td>478.0 (1053)</td>
<td>482.0 (1016)</td>
<td>50.18 (110.4)</td>
</tr>
<tr>
<td>Cow weight change, kg/day (lb/day)</td>
<td>.04 (0.08)</td>
<td>-.02 (0.04)</td>
<td>.31 (0.09)</td>
</tr>
<tr>
<td>Cow fatness, mm (in)</td>
<td>7.3 (0.29)</td>
<td>6.0 (0.24)</td>
<td>3.59 (0.14)</td>
</tr>
<tr>
<td>Cow fatness change, mm/day x 10(^2) (in/day)</td>
<td>1.6 (0.063)</td>
<td>4 (0.016)</td>
<td>1.80 (0.071)</td>
</tr>
</tbody>
</table>

\(a\)Least squares means from the model: \(Y = \) yr, sex, calf birth date, pasture type, all 2-way interactions excluding those involving yr.

\(b\)Residual standard deviation from the model.

\(c,d\)Means on the same line within the same date with different superscripts are different (P<.05).

\(e,f\)Means on the same line within the same date with different superscripts are different (P<.01).
<table>
<thead>
<tr>
<th>Item</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>April 30</td>
</tr>
<tr>
<td></td>
<td>Fescue-legume</td>
</tr>
<tr>
<td>Milk production, kg/day (lb/day)</td>
<td>6.2c (13.6)</td>
</tr>
<tr>
<td>Milk DE production, Mcal/day</td>
<td>4.4e</td>
</tr>
<tr>
<td>Calf weight, kg (lb)</td>
<td>151.4c (333)</td>
</tr>
<tr>
<td>Calf weight change, kg/day (lb/day)</td>
<td>.79e (1.74)</td>
</tr>
<tr>
<td>Conversion of forage DE intake by cow to milk energy, Mcal/Forage DE/Mcal milk GE</td>
<td>6.8c</td>
</tr>
<tr>
<td>Conversion of forage DE intake by cow above maintenance to milk energy, Mcal forage DE/Mcal milk GE</td>
<td>2.9c</td>
</tr>
<tr>
<td>Conversion of forage DE intake by cow and calf to calf growth, Mcal forage DE/kg calf growth (DE/lb)</td>
<td>54.9e (25.0)</td>
</tr>
</tbody>
</table>

\(^a\)Least squares means from the model: \( Y = \) yr, sex, calf birth date, pasture type, all 2-way interactions excluding those involving yr.

\(^b\)Residual standard deviation from the model.

\(^c,d\)Means on the same line within the same date with different superscripts are different (P<.05).

\(^e,f\)Means on the same line within the same date with different superscripts are different (P<.01).

\(^9\)Estimates of efficiency were calculated only for the last 4 yrs of the 5 yr project.
Table 3. (Continued) Patterns of milk production, calf growth and efficiency of Angus cows and calves grazing fescue-legume.

<table>
<thead>
<tr>
<th>Date</th>
<th>July 29</th>
<th></th>
<th></th>
<th>Aug 29</th>
<th></th>
<th></th>
<th>Sept 28</th>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Fescue-legume</td>
<td>Fescue</td>
<td>RSD</td>
<td>Fescue-legume</td>
<td>Fescue</td>
<td>RSD</td>
<td>Fescue-legume</td>
<td>Fescue</td>
<td>RSD</td>
</tr>
<tr>
<td>Milk production, kg/day (lb/day)</td>
<td>4.4$^c$ (9.7)</td>
<td>3.8$^d$ (8.4)</td>
<td>1.73 (3.81)</td>
<td>3.9$^c$ (8.6)</td>
<td>3.3$^d$ (7.3)</td>
<td>1.85 (4.07)</td>
<td>3.5$^c$ (7.7)</td>
<td>2.9$^d$ (6.4)</td>
<td>2.00 (4.40)</td>
</tr>
<tr>
<td>Milk DE production, Mcal/day</td>
<td>3.1$^e$</td>
<td>2.6$^f$</td>
<td>1.32</td>
<td>2.8$^c$</td>
<td>2.3$^d$</td>
<td>1.42</td>
<td>2.5$^c$</td>
<td>2.0$^d$</td>
<td>1.53</td>
</tr>
<tr>
<td>Calf weight, kg (lb)</td>
<td>223.8$^e$ (492)</td>
<td>207.9$^f$ (457)</td>
<td>25.29 (55.6)</td>
<td>248.1$^e$ (546)</td>
<td>228.3$^f$ (503)</td>
<td>28.30 (62.3)</td>
<td>272.9$^e$ (600)</td>
<td>249.3$^f$ (549)</td>
<td>31.94 (70.3)</td>
</tr>
<tr>
<td>Calf weight change, kg/day (lb/day)</td>
<td>.81$^e$ (1.78)</td>
<td>.70$^f$ (1.54)</td>
<td>.148 (.326)</td>
<td>.82$^e$ (1.80)</td>
<td>.69$^f$ (1.52)</td>
<td>.171 (376)</td>
<td>.83$^e$ (1.83)</td>
<td>.69$^f$ (1.52)</td>
<td>.194 (427)</td>
</tr>
<tr>
<td>Conversion of forage DE into milk energy, Mcal Forage DE/Mcal milk GE</td>
<td>11.6$^e$</td>
<td>8.9$^f$</td>
<td>7.02</td>
<td>14.7$^c$</td>
<td>11.3$^d$</td>
<td>11.78</td>
<td>19.0$^c$</td>
<td>15.4$^d$</td>
<td>20.55</td>
</tr>
<tr>
<td>Conversion of forage DE intake by cow above maintenance to milk energy, Mcal forage DE/Mcal milk GE</td>
<td>4.4$^e$</td>
<td>1.2$^f$</td>
<td>2.49</td>
<td>5.1$^e$</td>
<td>1.4$^f$</td>
<td>4.43</td>
<td>6.0$^e$</td>
<td>2.5$^f$</td>
<td>8.97</td>
</tr>
<tr>
<td>Conversion of forage DE intake by cow and calf to calf growth, Mcal forage DE/kg calf growth (DE/lb)</td>
<td>72.0$^e$ (32.7)</td>
<td>49.5$^f$ (22.5)</td>
<td>33.21 (15.09)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

aLeast squares means from the model: Y = yr, sex, calf birth date, pasture type, all 2-way interactions excluding those involving yr.
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Estimates of efficiency were calculated only for the last 4 yrs of the 5 yr project.
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